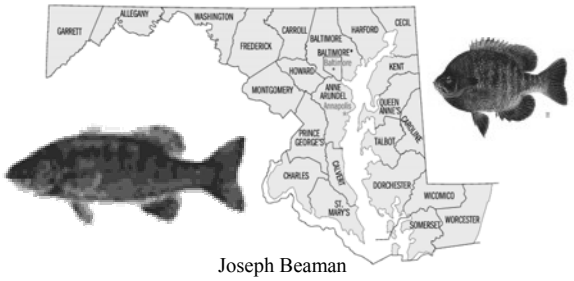
Consumption Advisories Based On 8 Meals/Month



Joseph Beaman
Maryland Department of The Environment
2002 National Forum on Contaminants in Fish

Overview of MD RA Policies: Fish Consumption Advisories

- **Provide Guidance for Three Populations:**
  - General Population
  - Women of Child-Bearing Age (18-45 years of age)
  - Young Children (0-6 years of age)
- **Consider Carcinogenic/NonCarcinogenic Effects**
- **Meal Size (Wet Weight in oz)**
  - 8 Oz. - General Population
  - 6 Oz. - Women of Child Bearing Age
  - 3 Oz. - Children 0-6 Years of Age
- **Meal Thresholds For Allowable Fish Consumption**
  - Do Not Eat (Less Than 4 meals/year)
  - 4 – 11 meals per year
  - 1, 2, 4, or **8** meals per month (> 4 meals = 8)

Basis For 8 Meal/Month Advisory Recommendations

- POLICY DECISION Based on:
- Anecdotal knowledge exists for subsistence/frequent fish consumer populations in several areas of the State:
  - **Baltimore City**
  - **Urban MD near Potomac River**
  - **Eastern/Western Shores of the Chesapeake Bay**
- Was not based on Exposure Assessment data from fish consumer populations in MD.

Risk Assessment Equations

- Calculate acceptable concentration of contaminant in fish tissue
- $[PCBs] = \frac{RL \times BW \times LT \times T_{ap}}{CSF \times MS \times MF \times ED \times ((100 - \%\ loss)/100)}$
- $[Methyl\ Mercury] = \frac{RfD \times BW \times LT \times T_{ap}}{MS \times MF \times ED}$

What Does 8 Meals/Month Mean? Carcinogens

- **Resulting Threshold Ranges For 8 Meals/Month (i.e. PCBs)**
  - General Population 20 – 39 ppb
  - Women of Child Bearing Age 17 – 33 ppb
- **RA Parameters (Carcinogens)**
  - 1 x 10^{-5} Risk Level
  - Standard Population Bodyweights
  - 70 Year Lifetime
  - 30 Year Exposure Duration
  - Upper Estimate Cancer Slope Factor (PCBs = 2)
  - Cooking Loss (General Population Only)
  - Used Non-Carcinogenic Effects for Children (more conservative)

Consumption Thresholds - PCBs

Meals/Month	General Population	Women 18-45	Children 0-6
8 meals/month	20 - 38	17 - 32	13 - 25
4 meals/month	39 - 77	33 - 66	26 - 51
2 meals/month	78 - 155	67 - 133	52 - 103
1 meals/month	156 - 312	134 - 266	104 - 207
< 1 meal/month	> 313	> 267	> 208

What Does 8 Meals/Month Mean? Non-Carcinogens

- **Resulting Threshold Ranges For 8 Meals/Month**
  - General Population 59 – 117 ppb
  - Women of Child Bearing Age 54 – 107 ppb
  - Children 0-6
    - PCBs 13 – 26 ppb
    - Mercury 32 – 64 ppb
- **RA Parameters (Non-Carcinogens)**
  - RfD (Mercury) = 0.1 ug/kg day; (PCBs .05 ug/kg day)
  - Standard Population Bodyweights, Meal Sizes
  - 70 Year Exposure Duration

Consumption Thresholds - Mercury

Meals/Month	General Population	Women 18-45	Children 0-6
8 meals/month	59 - 117	54 - 107	32 - 64
4 meals/month	117 - 235	107 - 215	65 - 129
2 meals/month	236 - 469	216 - 429	130 - 258
1 meals/month	470 - 939	430 - 858	259 - 519
< 1 meal.month	> 940	> 858	>519

Data Decision Rules: Advisories

- Generally, need a minimum of 5 fish (individual or composite) to establish advisory.
- For 2001, Advisories, only used data back to 1995.
- Calculate thresholds using Geometric Mean when sufficient individual or more than 1 composite exists.
- Less than 5 fish may be used when contaminant levels warrant advisories in the meal/year (< 1 meal/month) category and
  - Waterbody is confined (i.e. lake)
  - Fish species is resident (i.e. channel catfish, bullhead spp.)

MD Lakes/Impoundments

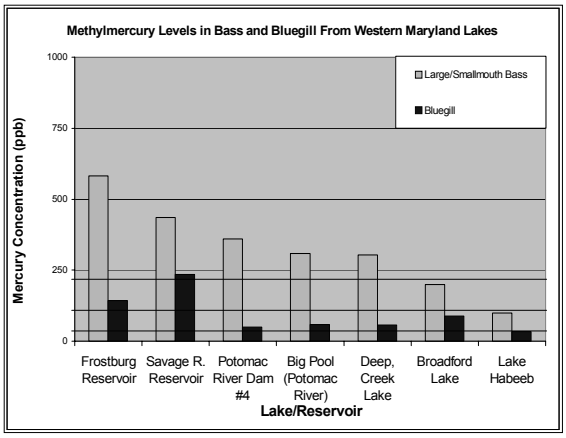
- Approx. 372 "Lakes" Total
- 1 or 2 Natural Lakes
- 30 Lakes > 100 acres
- 275 Lakes/Ponds < 1 – 20 acres

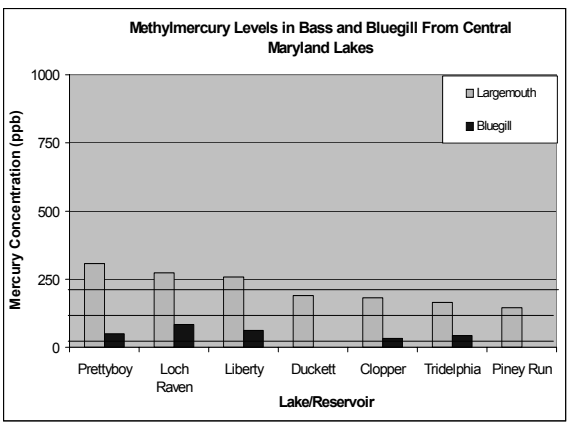
Data Supporting Hg Advisories: Statewide Lakes/Impoundments

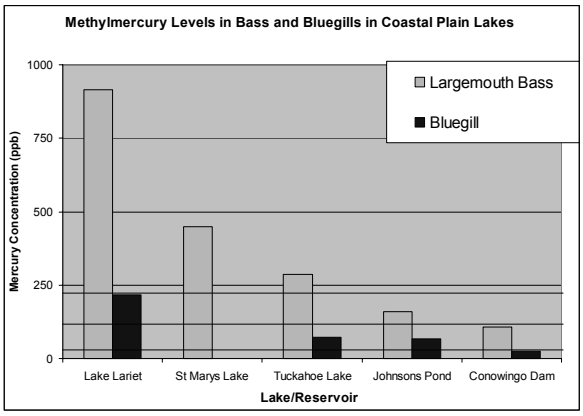
- **MD DNR Power Plant Research Initiative**
- **20 Lakes – Min size 80 acres**
- **Target SpeciesCollected**
  - Large/Smallmouth Bass
  - Bluegill/Sunfish
  - Black Crappie
- **10-15 individuals/species**
- **THg/MeHg Analyzed**

Setting the Statewide Advisory

- 19/32 (59.4%) of lakes/impoundments > 80 acres had sufficient data to generate consumption advisories for bass, bluegill, and/or crappie
- 13/32 (40.6%) > 80 acres of lakes/impoundments had sufficient data to generate consumption advisories bluegill.
- First, geometric mean MeHg (or T Hg when MeHg not available) were calculated for individual waterbodies.
- The average of the geometric means was calculated and used to determine the appropriate level for the advisory, based on EPA risk assessment methodology for mercury





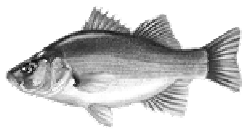


Data Summary for Statewide Advisories

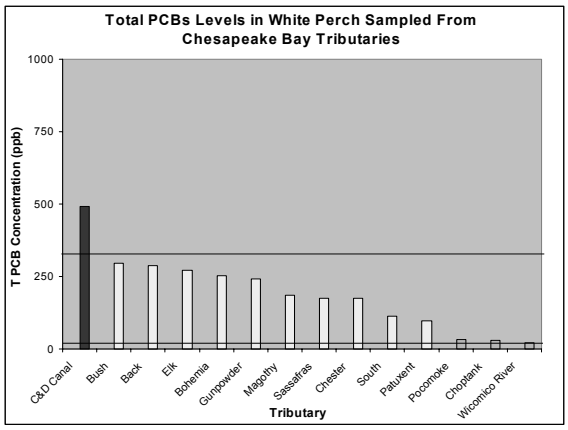
- Lakes/Impoundments
- 13 Lakes
- 181 Ind. Bluegill Sampled
- Average MeHg = 61 ppb
- STD = 29.8 ppb
- Min: 24 ppb; Max: 133 ppb

- Rivers & Streams
- 6 Rivers/Streams
- 29 Bass Sampled – Composites (4-5 fish)
- Average MeHg = 60.7 ppb
- STD = 40.4 ppb
- Min: 47 ppb; Max 123 ppb
- Advisory was conservative based on trends observed in rivers
- Additional sampling needed

PCB Advisories: 8 Meals/Month



- White Perch Only
- Lower Eastern Shore Rivers Only
  - Choptank
  - Nanticoke
  - Pocomoke
- Average 27.6 ppb
- Std. Dev. 5.2 ppb
- 30 Fish Sampled – 2 composites of 5 per river



Potential Advantages of the 8 Meal/Month Advisory

- Provides information to fish consumers (including subsistence populations) as to the locations and species of fish that can be consumed frequently without increased risk of health effects.
- Provides some assurance that fish species with recommendations based on 8 meals/month have relatively "low" (based on risk assessment procedures) concentrations of bioaccumulative contaminants.

Potential Disadvantages of the 8 Meal/Month Advisory

- Unintended negative consequences:

- Some consumers may stop eating fish if there is an advisory of any type, thereby negating the benefits of fish consumption, even though contaminant levels were relatively low.
- Fish Consumption Advisories may cause unintended and potentially unnecessary negative impacts on recreational and/or commercial fisheries. **(RFF Report)**
- Potential Regulatory Disadvantages (TMDLs)
- Confusion in interpretation of advisory information

Outstanding Issues

- Exposure Assessment:

- Currently conducting mail surveys among MD licensed anglers and interviews in urban areas

- Assessment Questions:

- What are the proper fish consumption levels at which to assess risk in the State? Do we need to go to 8 meals? Higher or Lower?
- How should we categorize/group populations in areas with fish consumers?

Impacts of Fish Contamination in the Columbia River Basin

- **Fish Contamination Study**
- **Fish Advisory Issues**

Columbia River Basin

Member Tribes of the Columbia River Inter-Tribal Fish Commission (CRITFC):

- **Nez Perce**
- **Umatilla**
- **Warm Springs**
- **Yakama**

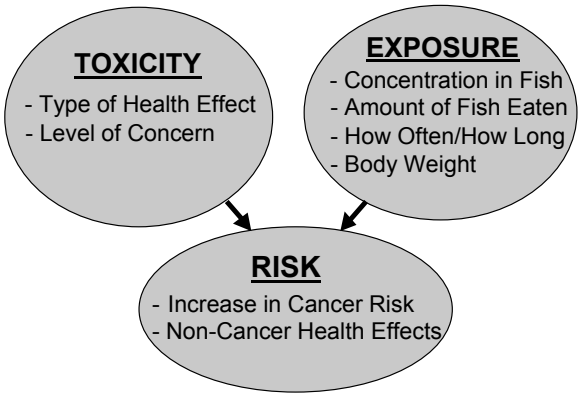
Total of 14 Tribes in the Columbia River Basin

Purpose of Fish Contamination Study

To Evaluate the Likelihood that Native American Tribal Members may be Exposed to High Levels of Contaminants through Consumption of Columbia River Basin Fish.

Phase 1: Fish Consumption Survey 1990-1994 (CRITFC)

Phase 2: Fish Contamination Survey 1996-2002 (USEPA)



Phase 1

Fish Consumption Survey

(CRITFC, 1990-1994)

The Fish Consumption Survey was Designed to Answer the Questions:

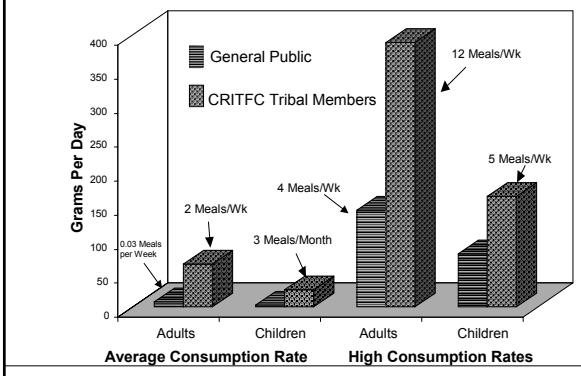
Are Tribal Members Eating More than the National Average (6.5 Grams) used by USEPA?

Are Tribal Members Adequately Protected by Water Quality Standard Based on the National Fish Consumption Rate?

Percent of Each Species in Hypothetical Multiple Species Diet (CRITFC Study)

Salmon	**28%**
Rainbow Trout	**21%**
Mountain Whitefish	**7%**
Eulachon	**16%**
Lamprey	**16%**
Walleye	**3%**
White Sturgeon	**7%**
Largescale Sucker	**2%**

1994 Fish Consumption Survey Results



The Fish Consumption Survey was Designed to Answer the Questions:

Are Tribal Members Eating More than the National Average (6.5 Grams) used by USEPA?

Yes. Adults 58.7 Grams, Children 19.6 Grams.

Are Tribal Members Adequately Protected by Water Quality Standard Based on the National Fish Consumption Rate?

Probably Not. More Study Needed.

Phase 2

Fish Contamination Survey

(USEPA, 1996-2002)

The Fish Contamination Survey was Designed to Answer the Following Questions:

Are the Fish Contaminated?

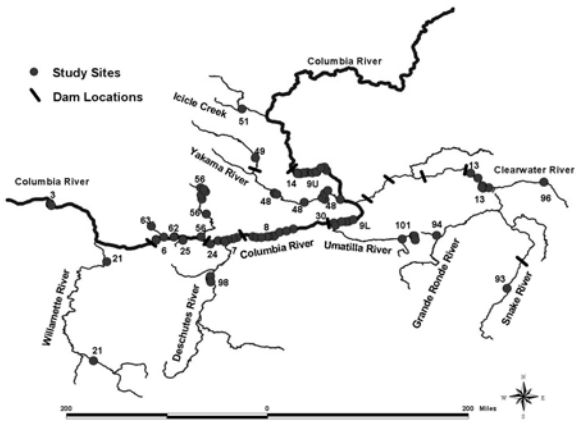
Is there a Difference in Contaminant Concentrations Among Species and Location?

Are the Tribes Exposed to a Higher Risk?

This Fish Contaminant Study was Not Designed to Evaluate:

- People's Health
- Intergenerational Risks
- Rates of Disease
- Sources of Chemicals
- Multiple Exposures

The Study Design was not Random.



Columbia River Basin Study Sites

Fish Sampling


Gillnetting for Salmon

298 Fish Samples from 3 Replicates per Site.

26 Sample Locations on Mainstem Columbia River & 14 Tributaries.

Samples Obtained for Tribal Fishers and from Hatcheries.


Sturgeon at Hanford K Ponds

Resident Species:

- White Sturgeon
- Mountain Whitefish
- Rainbow Trout
- Walleye
- Bridgelip
- Largescale Sucker


Steelhead

Anadromous Species:

- Spring Chinook
- Fall Chinook
- Coho
- Steelhead
- Eulachon (Smelt)
- Pacific Lamprey (Eels)

Various Sample Analyses:

- 145 Whole body, 132 Fillet & 11 Egg Samples.
- Fillet with Skin (Except White Sturgeon).
- Composites Samples (Except White Sturgeon).


Steelhead Fillet

Analyzed for 132 Chemicals (92 Detected)

USEPA Scientist

21 Pesticides
16 Inorganics (Mercury, Arsenic)
3 Aroclors
13 Dioxin-like PCBs
17 Chlorinated Dioxins & Furans
22 Semivolatiles, eg PAHs

Toxicity Assumptions for Chemicals Contributing the Highest Risks

Central Nervous System
Mercury
Arsenic

Cardiovascular
Arsenic

Keratosis
Arsenic

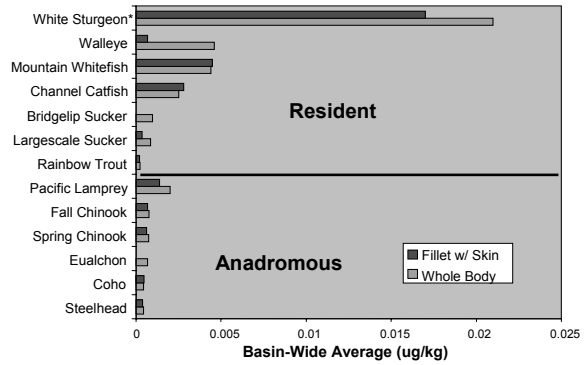
Immune System
Aroclors

Reproductive System
Mercury

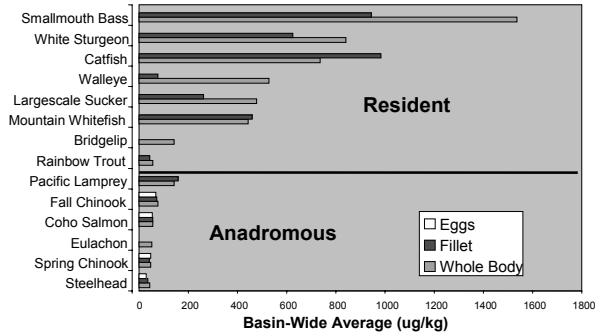
Liver
DDT/DDE/DDD

Cancer
Dioxins/furans (B2)
Dioxin-like PCBs (B2)
Inorganic Arsenic (A)
DDT/DDE/DDD (B2)

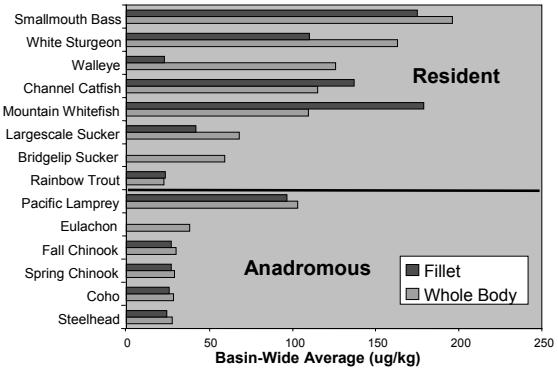
Dioxin (2.3.7.8 TCDF)



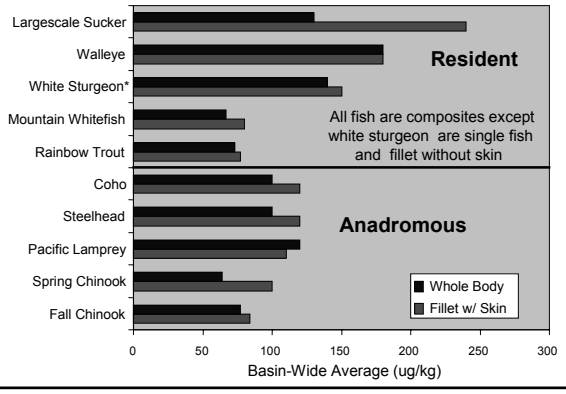
Pesticides



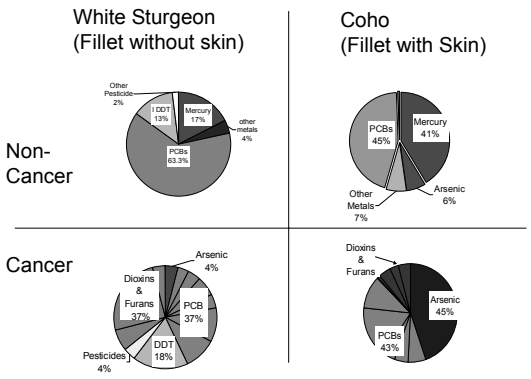
Aroclors



Mercury



Percent Contribution of Chemicals to Health Effects



Mixed Diet Results

CRITFC Tribal Data
Average Fish Consumption, 70 Years Exposure

	Percentage of Hypothetical Diet	Consumption Rate (grams/day)	Cancer Risk	Noncancer Effects (HI)
Salmon	27.7	17.5	6×10^{-5}	0.6
Rainbow Trout	21.0	13.3	4×10^{-5}	0.3
Mountain Whitefish	6.8	4.3	9×10^{-5}	0.7
Eulachon	15.6	9.9	3×10^{-5}	0.1
Lamprey	16.3	10.3	1×10^{-4}	0.7
Walleye	2.8	1.8	4×10^{-6}	0.1
White Sturgeon	7.4	4.7	7×10^{-5}	0.6
Largescale Sucker	2.3	1.5	9×10^{-6}	0.1
Totals	**100.0**	**63.2**	**4×10^{-4}**	**3.2**
			$< 10^{-6}$ Problem	**> 1 Problem**

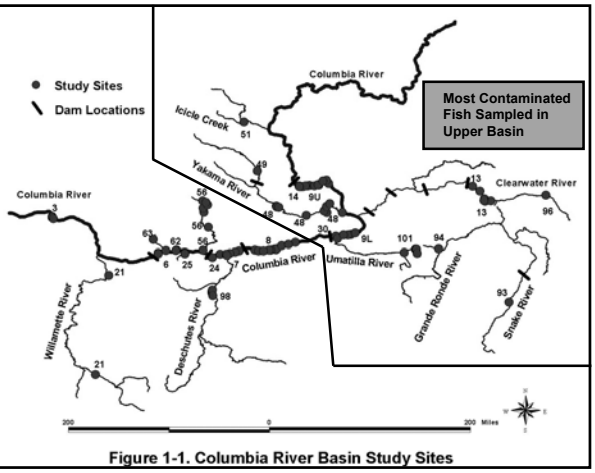


Figure 1-1. Columbia River Basin Study Sites

The Fish Contamination Survey was Designed to Answer the Following Questions:

Are the Fish Contaminated?
Yes.

Is there a Difference in Contaminant Concentrations Among Species and Location? Yes.

Are the Tribes Exposed to a Higher Risk?
Yes.

Conclusions

Resident Fish More Contaminated than Anadromous Fish.

Tribal Members Eat Significantly More Salmon than Resident Fish.

Fish Consumption Risk Much Higher for Tribal Members than for the General Population.

Conclusions (continued):

USEPA Concludes the Columbia Basin Fish Contamination Results are Similar to other Large River Basins in the US.

Stressing this USEPA Conclusion Downplays the Importance of Addressing this Critical Issue for Tribes in the Columbia River Basin.

Issues to Address while Considering a Fish Advisory in the Columbia River Basin

Cultural Importance of Salmon

Treaty Fishing Rights

Tribal Fishery at Celilo Falls

Treaties of 1855 Guaranteed "the Right of Taking Fish at All Usual and Accustomed Places"

This Means Taking Fish that will Nourish, Not Harm, the Health of our Bodies.

Human Health

Traditional Diet vs. Toxic Fish

Personal Health of Tribal Members is the Highest Priority of Tribal Governments.

Fish Preparation Methods May be an Issue.

Personal Health = Physical, Mental, Spiritual & Cultural

Fish Health

Research & Analysis Needs are Substantial (Pathology, Toxicology, etc.).

Hagerman Lab in Idaho is Currently Being Built.

Fish Health Issues Tends to Get Lost in the Shuffle.

Economic

Tribal Fisher Selling Salmon to the Public

Economic Benefit to Tribal Members is Significant (~$2M Annually).

Major Tribal Effort is Underway to Increase the Fishery Value.

Recent USEPA Report has Impacted Tribal Ability to Market Salmon.

Environmental Clean-Up

Hanford Nuclear Reactor

Past Hanford Contamination

Identification of Contamination Sources.

Legal Issues: ESA, CWA, Treaties with Tribes.

Political Process.

Environmental Justice.

Partnering with Environmental Organizations.

Tribal Limitations in Addressing the Risks and Benefits of Eating Salmon:

- Understanding Results
- Communicating to Tribal Members
- Coordinating Inter-Tribal Efforts
- Action to Clean Up the Water
- Lack of Funding

Dietary Benefits and Risks in Alaskan Villages

Principal Investigator:

•Mike Brubaker, Aleutian/Pribilof Islands Assn.

Regional Research Coordinator:

•Sue Unger, Aleutian/Pribilof Islands Assn.

St. Paul Coordinators:

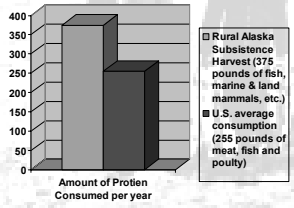
•Aquilina Lestenkof, Phil Zavadil & Blair Powless

Atka Coordinators:

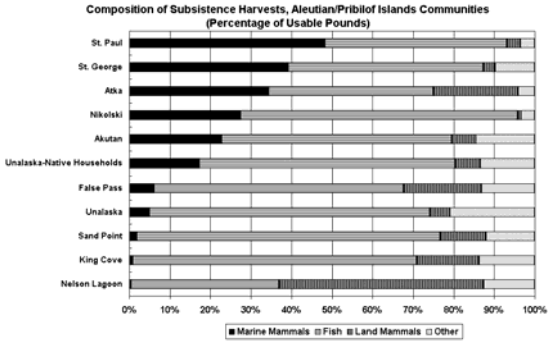
•Ray Golodoff & Margaret Lokanin

Subsistence Use in Alaska

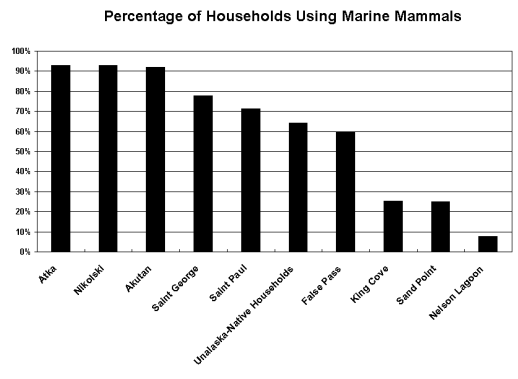
- 229+ tribes in Alaska
- Main subsistence food is fish- about 65 percent (salmon, halibut, herring, whitefish, cod, and Dolly Varden, etc.)



Subsistence Use in the Aleutian/Pribilof Region



Marine mammal use in the Aleutian/Pribilof Region



Purpose of Study:

- To encourage healthy dietary choices by raising awareness about rural diet and the risks and benefits unique to foods consumed in Atka and St. Paul.

Key Questions

- Is our traditional food safe to eat?
- What are the benefits of eating traditional foods? Risks?
- What are the benefits/risks of changing from a traditional diet to a more store-bought diet?

Benefits and Risks of Traditional Foods

Community Goal:

• Restore and maintain health lifestyles and cultural connection for this and future generations to achieve holistic community health* in Atka and St. Paul.

* *Community health* is defined as a natural interplay among cultural, physical, environmental, economic, spiritual, social and emotional forces.

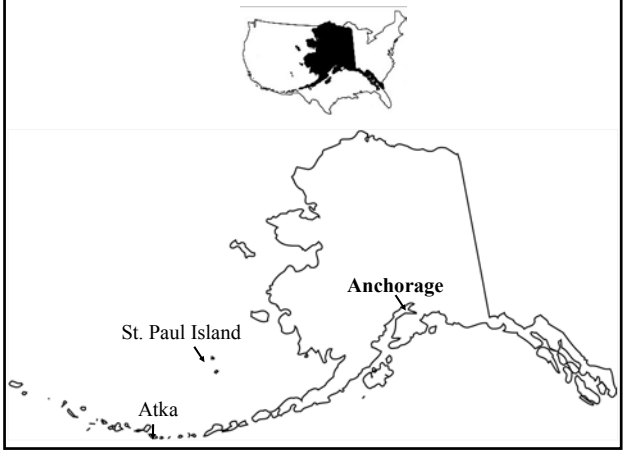
Hypotheses:

• Traditional foods are safe to eat and are an important part of a nutritious balanced diet.

• Maintenance of traditional diet enhances community cohesion, cultural connection and community and individual health.

• Increasing substitution of traditional foods with commercial foods in the diet are resulting in negative health effects.

• Many factors are influencing the collection, use and benefits of traditional foods.



How were study sites chosen?

St. Paul:

Study showing high content of Persistent Organic Pollutants in Northern Fur Seal

Dramatic changes in diet

Highest rate of increase in diabetes in State

Access to store foods

Atka:

Results from Persistent Organic Pollutants Study in 5 Aleutian and Pribilof Villages.

Proximity to Amchitka Island

High subsistence use area

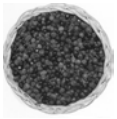
First communities to enroll in Maternal Cord Blood Sampling Program

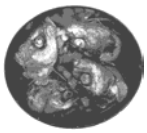
Unique Partnership

A/PIA	**Tribal Gov't of St. Paul**	**Atka IRA Council**	**UAA-Institute for Circumpolar Health**
Dept. of Environ. Conservation	**Dept. of Health & Social Services**	**Dept. of Fish and Game**	**Alaska Native Health Board**
Alaska Native Tribal Health Consortium	**US Environmental Protection Agency**	**U.S. Fish and Wildlife Service**	**Local Village Advisory Groups in St. Paul/Atka**

Process

- ***Dietary Surveys***: Finding out what foods people in the community are eating and *how much.*



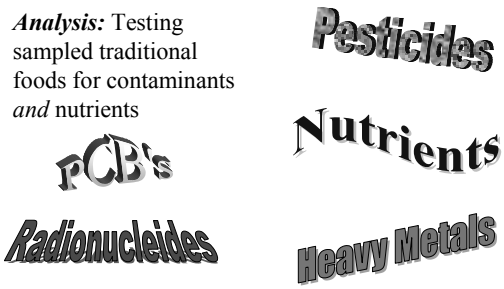

Process (cont.)

- ***Sampling:*** Traditional foods that are collected for subsistence will be sampled.



Process (cont.)

- ***Analysis:*** Testing sampled traditional foods for contaminants *and* nutrients



Process (cont.)

Education/Communication:

- Village Advisory Groups
- Public Meetings
- Working with the School
- Technical Advisory Team
- Film Project

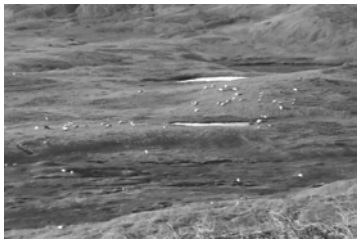
Project Objectives

The benefit-risk assessment for dietary choices will be designed to improve the understanding of and communicate:

- Pollutant levels in traditional foods
- Nutritional value of traditional foods
- Pollutant levels in commercial foods
- How to select and prepare foods to reduce exposure
- Ways to select a quality blended diet to enhance personal and community health.

Project Assumption

Objectives are based on assumptions that the *nutritional and cultural benefits of traditional foods are essential to holistic community health.*



"Diabetes and high blood pressure and all of that is a concern because of our diet change. We have nowadays more junk food available to us. Lack of exercise and more soda pop and sweets are available…"

"… It changes the way things used to be."

-Sally Swetzof, Atka

"…What does it (seal) have that makes me better able to live in this environment that is very windy, that is very wet and damp a lot of the time?"

-Aquilina Debbie Lestenkof, St. Paul

Overview of the Benefits of Fish Consumption

Judy Sheeshka, PhD, RD
University of Guelph
Guelph, Ontario

Outline

- Fish in 'healthy diets'
- Omega-3 fatty acids (n-3 FA) in fish
- n-3 FA in growth & development
- n-3 FA, fish & chronic disease
- Summary

- Benefits depend on:
  - Amount consumed
  - Species
  - Food displaced
- Generally, fish valued for:
  - High quality protein
  - 'Good' fatty acids, esp. n-3 FA
  - Vitamins & minerals

Protein quality = relative proportions of essential amino acids & their availability to the body

- Animal foods have 'complete' proteins
- Plant foods have 'incomplete' proteins
- Egg protein highest quality, then fish
- Look at total day's intake, not food substituted

Fish vs. other 'protein foods' (150 gram portions)

	Rainbow Trout	Perch (mixed)	Chicken breast (no skin)	Hot Dog
% kcal PRO	24 %	26 %	27 %	15 %
% kcal FAT	37 %	33 %	34 %	52 %
% kcal CHO	39 %	41 %	39 %	33%
total Kcal/d	1148	1099	1171	1396

Fat

- New dietary reference intakes (DRIs, 2002) recommend:
  - 20-35% of total calories from fat
  - Low saturated fat
- Saturated fatty acids (SFA) – mostly in meats, baked goods, high-fat dairy
- SFA – raise serum LDL cholesterol ('bad')

- Mono & poly-unsaturated fatty acids (MUFA & PUFA) – fish, veg oils, nuts
- MUFA & PUFA lower serum LDL ('bad') & raise HDL ('good' cholesterol')
  = lower risk of heart disease

	Lean Fish	Fatty Fish	Beef	Chicken
SFA	25%	25%	40-45%	30-35%
MUFA	25%	50%	50%	35-40%
PUFA	50%	25%	5-10%	25-30%

Omega-3 Fatty Acids

- Type of PUFA found in fish, flaxseed oil
  - DHA 22:6n-3
  - EPA 20:5n-3
- Amts in lean fish = 0.3 - 0.5 g/100 g fish
- Amts in fatty fish = 0.8 - 1.0+ g/100 g fish
- Fish from colder waters – more n-3 FA

N-3 FA (g/100 g fish)

	C20:5 EPA	C22:6 DHA
Bass, mixed-species	0.305	0.458
Coho salmon	0.401	0.658
Rainbow trout	0.468	0.560
Fresh-water drum	0.295	0.368

N-3 FA (g/100 g fish)

	C20:5 EPA	C22:6 DHA
Channel catfish	0.100	0.137
Northern pike	0.042	0.095
Walleye	0.110	0.288
Yellow perch	0.101	0.223

N-3 FA & Mercury

	EPA & DHA g/100 g fish	Mercury Mean ppm
Bass, mixed-species	0.763	0.46 - 0.52
Northern pike	0.137	0.36
Walleye	0.398	0.43 – 0.77
Yellow perch	0.324	0.25 - .040

N-3 FA & Contaminants

- Fattier, predatory fish (e.g., swordfish, king mackerel):
  - Higher n-3 FA but also higher mercury, PCBs where these a problem
- Halibut, pollock, catfish, sablefish, herring lower in mercury, modest amts n-3 FA

Farmed vs Wild Fish

- Debate re: n-3 FA in farmed vs wild fish
- Type of feed important
- Farmed fish have higher total fat, so n-3 as % of total FA is lower
- But appears that n-3 FA /100 g farmed fish same as for wild fish

Summary of Nutritional Benefits

- Fatty fish comparable to lean meats & skinless poultry in:
  - amount of protein, fat, cholesterol
  - quality of protein
- But proportions of SFA, MUFA & PUFA better in fish
- Cheese, processed meats & eggs have more fat & cholesterol
- Plant foods (e.g., pasta, rice) have poorer quality protein

Summary of Nutritional Benefits

- Only fish have n-3 FA
  - Levels higher in cold water, fatty fish
  - Predatory high fat fish may be high in mercury (e.g., king mackerel, swordfish)
  - Fish with modest amts n-3 FA & low mercury: halibut, catfish, yellow perch

Omega-3 FA in Growth & Development

- cell membranes of retina, brain & central nervous system
- important during 3rd trimester pregnancy to 12 mos. of age
- during pregnancy & lactation, fish in mother's diet provides n-3 FA to baby
- controversy over need for n-3 FA in commercial infant formulas

- Faroe Islands Study - women who ate more marine animals & fish during pregnancy had longer gestations & heavier babies
- Clinical study of Danish women found similar results (Olsen et al., 1992)
- Inuit women had lower blood pressure at end of pregnancy (Popeski et al., 1991)

N-3 FA, Fish & Chronic Disease

- Heart Disease – Prospective Studies
  - Overall, results suggest 1-2 fish meals/wk may reduce risk of CHD & all-cause mortality
  - N-3 FA reduce triglycerides, but effects on LDL, HDL & total cholesterol inconsistent

- Heart Disease – Secondary Prevention
  - DART & GISSI studies of MI survivors
    - fish meals (2x/wk for 2 yrs) or n-3 FA pills (1 g/d) lowered mortality rates
  - Von Shacky (1999) – intervention to halt progression of CVD; 6 g/d n-3 FA for 3 months, then 3 g/d for 21 months
    - modest effect on disease progression but LDL increased

Issues

- Different cardiac endpoints
- Mechanism not yet known
- Some effects don't increase with dose
- Lean fish produce same effects as fatty fish
- N-3 FA pills vs amt n-3 FA in fish
- Studies mostly well-educated men

Health Recommendations

- American Heart Assoc. (2000) recommends

  "eat at least 2 servings of fish per week"

- FDA (2000) allows '*qualified*' health claim
  - "Scientific evidence about whether n-3 FA may reduce the risk of CHD is suggestive, but not conclusive."

Cancer & Stroke

- Case-control studies provide evidence that small amts of fish may be protective against certain cancers, esp. in GI tract

- Stroke – depends on whether ischemic or hemorrhagic; results mixed, but evidence of lower mortality from ischemic stroke

High blood pressure

- Several studies suggest that adding fish to diets can lower blood pressure, esp. in combination with low fat, low sodium, weight loss diets & exercise

- NHLBI (Oct. 2002) – re: n-3 FA pills "lower blood pressure only slightly in individuals with hypertension"

Type II Diabetes Mellitus

- Concern that fish worsens blood sugar levels
- CARDIA study (Daviglus, 2002) – moderate amts of fish don't raise blood glucose levels
- Some researchers say amt of fat in diet is important – fish added to 30% fat diet ok

Conclusions

- All fish contain n-3 FA, critical during pregnancy & 1st year of life
- Not clear if n-3 FA provide CHD benefits, since lean fish also associated with lower mortality rates & only 1-2 meals/wk needed
- People with Type II Diabetes may benefit from eating more fish as part of a low-fat diet, with blood glucose levels monitored

'Take Home' Messages

- Regardless of whether effects are due to fish or n-3 FA, consistent finding that eating *no fish is a health risk*
- 1-2 meals/wk appears to provide CHD benefits; more fish $\neq$ more protection from chronic disease
- N-3 FA in fat tissues, Hg in muscle tissues; can choose lower Hg, higher n-3 FA species

Use of Quality Adjusted Life Years to Assess Risks and Benefits of Fish Consumption

Scott Bartell, PhD Candidate UC Davis
Mike Bolger, PhD US FDA
Clark Carrington, PhD US FDA
Elaine Faustman, PhD UW
Denise LaFlamme, MS WA Dept of Health/UW
Robert Lee, MS Univ. of Calgary
Rafael Ponce, PhD UW
Eva Wong, PhD Student UW

Risks and Benefits of Fish or Seafood Consumption

Benefits

- **High nutritional quality**
- **(Often) inexpensive**
- **(Often) easily obtained**
- **Associated with variety of health benefits**
  - Cardiovascular disease
    - Antiatherogenic
    - Antithrombotic
  - Neurodevelopment
- **Socio-cultural associations**

Risks

- **May contain harmful environmental toxicants**
  - Heavy metals
    - Methylmercury
    - Cadmium
  - Organochlorine compounds
    - Pesticides
    - PCBs
- **Risk substitution**

Decision Context/Problem

How can one conduct environmental health policy analysis when disparate health endpoints are at risk?

Public health policy and fish consumption

Ideal policy tool would

- allow consideration of both risks and benefits
- be transparent, rigorous, theoretically well-founded
- allow consideration of uncertainties, correlations
- be flexible and allow updating with new information

Available Tools

- Risk analysis (compare disease incidence to identify best policy)
- Benefit-cost analysis (do the benefits of implementing policy outweigh costs?)
- Cost-effectiveness analysis (which policy option has highest effectiveness per unit cost?)

⇨ In any analysis, you need similar "units"

Risk analysis (compare disease incidence to identify best policy)

Comparisons of risk not sufficient for health policy decision making

- Using risk and “ignoring” consequences assumes consequences are equivalent
- This assumption is hidden in the comparison

When Are "Health Endpoints Equivalent"?

1. An individual is ambivalent between the two health effects (QALY, willingness to pay/accept)
2. Health effects have comparable duration (workdays lost, life years lost)
3. Health effects have comparable cost (disability cost, Medicare reimbursement cost, insurance cost)
4. Health effects have comparable population impact (hospitalization rates, mortality rates)

Characteristics of QALYs

- **QALYs disaggregate health effects**
  - Duration of impact (life years) [Life tables]
  - Quality of life (0-1, death-perfect health) [Surveys]
- **In simplest form, QALYs assume:**
  - Duration and quality of life are independent
  - Linear and constant exchange between duration and quality of life

0.5 years of perfect health = 1 year of 50% health

QALYs cont.

- **Assess preferences/aversions for different health states**
  - Including symptoms, pain, functional impairment
  - Preferences scaled (typically 0-1)
    - 0 is death
    - 1 is optimal health
- **QALY scale data combined with the duration of impact**

QALYs

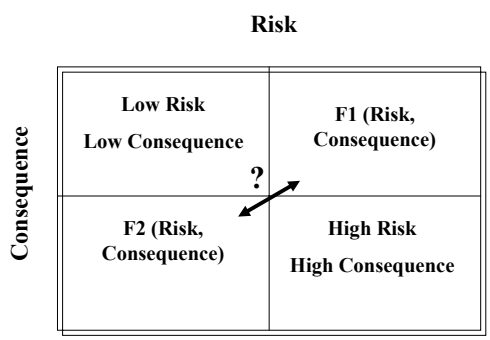
- **Extensive literature**
- **"QALY" search on Medline = 1600 articles**
- **Cost-effectiveness comparisons of**
  - Alternative therapeutic/surgical regimens
  - Screening programs
  - Disease burden
  - Training programs

Estimating net benefit/risk

1. Use measure of equivalency (e.g., QALYs) to adjust the dose-response functions

2. Normalized dose-response functions can be directly compared

3. Normalized dose-response functions can be combined to get a 'net health impact'



Use of QALY Weights with Dose Response Models for Public Health Decisions:
Case Study of the Risks and Benefits of Fish Consumption
Risk Anal 2000 20(4):529-42

Quality adjusted life years (QALYs) and dose-response models in environmental health policy analysis -- methodological considerations.
Sci Total Environ 2001 274(1-3):79-91

Analytical (not so) Small Print

- Analysis performed as a case example
- Although realistic data used in derivation, not intended as a definitive analysis
- A number of assumptions made that need careful consideration

1) Problem definition

- **Net health impact of eating fish**
  - Single benefit and risk endpoint considered
  - Risk: Neurodevelopmental delay from prenatal MeHg exposure
  - Benefit: Reduced risk of fatal MI with eating fish
- **Population selection**
  - General population of 100,000
  - 100,000 women of child-bearing age and their children

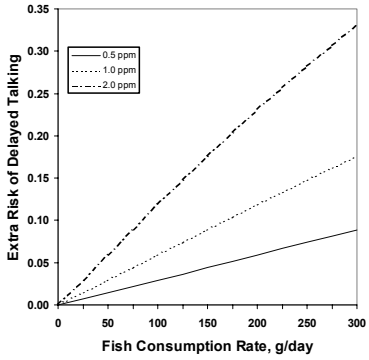
2) Data collection

MeHg intake

- **Evaluated 0-300 g/day fish intake rate**
  Includes 99th percentile of heavy fish consumers in lower 48 states
- **Fish MeHg concentrations**
  Assumed 0-2 ppm MeHg

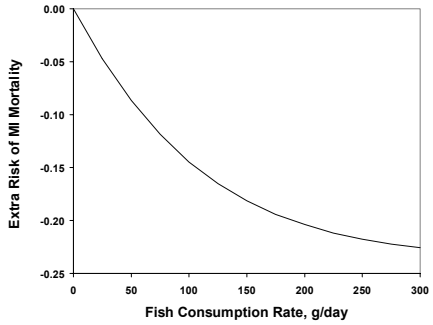
3) Modeling Risks

- **Used Marsh et al. (1987) data**
- **Weibull dose-response model (US EPA)**
- **Estimated risk of neurodevelopmental delay from MeHg in fish**
  - Specify quality of life factor using survey data (0.9)
  - Assume lifetime impact at reduced quality of life
  - Life table approach used to estimate expected lifespan
  - Assume MI risk and neurodevelopmental delay risk are independent



4) Modeling Benefits

- **Use CDC data**
  - Estimated lifespan using age- and gender-specific mortality rates by all causes and MI
- **Used Daviglus et al. (1997) to estimate benefits of fish consumption (Logistic excess risk model)**
  - Modify age-specific MI mortality rates by RR and estimate lifespan by gender
  - Assume male-only RRs apply to females, constant across age groups
  - Assume quality of life drops from 1 to 0 with MI (1=life, 0=death)



Risk-Benefit Analysis

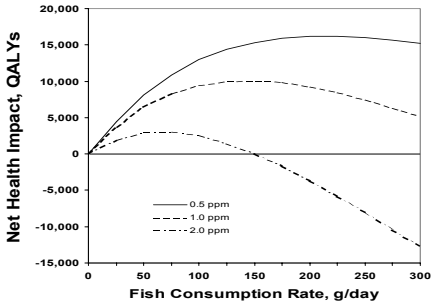
Aggregate risks/benefits of fish consumption

- Assuming equivalent health impacts
- Assuming QALY-weighted health impacts
- In a population of 100,000 (all ages, both genders)
- In a population of 100,000 child-bearing aged women and their children

- No discounting, effect of discounting, and all life years are equivalent

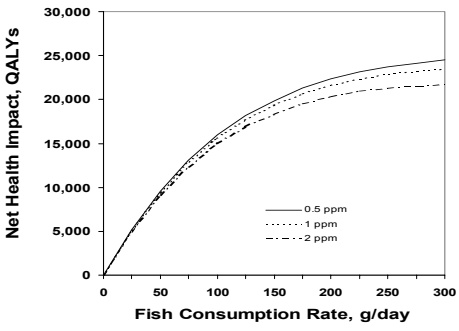
Net Health Impact, 100,000 men and women

Equal QALY weights



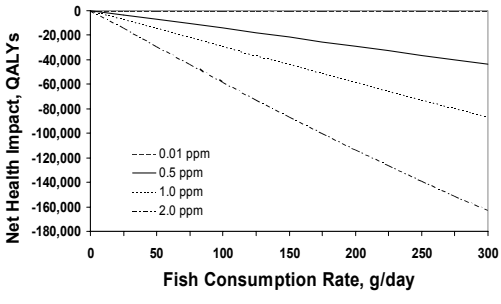
Net Health Impact, 100,000 men and women

Unequal QALY weights



Net Health Impact 100,000 women (15-44 y.o.) and their children

Unequal QALY weights



Conclusion

- **Under given model assumptions**
  - Population-wide restrictions on fish consumption would do more harm than good
  - Recommendations to limit fish intake during pregnancy would do more good than harm

Method Robustness

- Amenable to sensitivity and uncertainty analysis
  - Fertility rate, age distribution, gender comp.
  - QALY weights
  - Dose-response modeling
- Amenable to discounting, forecasting
- Can consider multiple benefits/risks
  - Endpoints appropriately weighted
  - Can incorporate correlations

Requirements/assumptions

- Requires
  - Data on health effects
  - Dose-response
  - Age-specific rates
  - Duration of effects
- Extrapolation of data from animals uncertain
- Requires quality of life weights for each considered endpoint

Parting words

Any aggregation/comparison of disparate health effects will require a weighting scheme

To ignore weighting is to assume that consequences are equivalent

Effect of Discounting